

XIII.—*Botanical Notices from Spain.* By M<sup>C</sup>RITZ WILLKOMM\*.

[Continued from vol. xv. p. 419.]

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WEARIED with the view of the endless plains of the Mancha, which present only an aspect of corn-fields and brown arid heath, here and there broken by a copse of the *Quercus Ilex* or *Pinus Pinca*, I was not a little delighted, when on the morning of the 10th of July I descried the blue mountain-ranges of the Sierra Morena, the frontier of the long-desired Andalusia. This long and wide chain of mountains, which rises in gentle gradations to a height scarcely exceeding 6000 feet, is at this point almost wholly covered with copses of oak. The rivulets, which are particularly numerous on the south side, permeating the valleys, and emptying their waters into the Guadalquivir, give birth to a richer vegetation than I had hitherto observed in the Spanish mountains, and were chiefly inclosed with flowering oleanders, ash-trees and elms, interspersed with the vine, which grows almost wild here, as in the lowest part of the Sierra Nevada, and hangs in picturesque festoons from the tops of the trees down to the ground. After traversing the celebrated Pass of Spiñasperros, and crossing many wide mountain-ridges, we arrive at the ancient Swabian colonies of S<sup>a</sup> Helena and Carolina; and the environs of these beautiful localities, especially of Carolina, show the traveller, by their fertility, that he has reached the happy land of Andalusia. Hedges of *Agave americana* and *Opuntia vulgaris*, which surround the interminable fields of wheat, maize, hemp, beans, garbanzos (*Cicer arietinum*, L.), tomato (*Lycopersicon esculentum*, Mill.), pimento (*Capsicum annum*, L.), plantations of mulberry-, olive-, almond- and vine-trees, which extend to the banks of the Guadalquivir, recall to mind the fruitful plains of Valencia. The extensive and very barren Sierra de Jaen separates the wide valley of the Guadalquivir from the noble Vega of Granada,—the former so celebrated in history, which extends at the foot of the Sierra Nevada, rising like an immense wall with snow-capped summits to more than 11,000 feet in height, and bounded on the west by the Sierra Tejada and Sierra de Alhama. Although, in the country around Granada, neither the date- and dwarf-palm, nor the orange-hedges of Valencia are found, yet the vegetation bears a far more southern character. I had nowhere before seen in Spain such a luxuriant and almost tropical vegetation, not excepting even Aranjuez, where it is evident that the cultivating hand of man has produced by artificial irrigation that rich growth of trees and plants of all kinds which convert this spot into a charming oasis in the deserts of New Castille.

On one of the peninsular tracts of land formed by the small but celebrated rivers of the Jenil and Darro lies the ancient royal city of Granada, at the foot of the proud Alhambra, whose Moorish towers crown the last offshoot of the rocky wall which divides the valleys

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of the Jenil and Darro, and forms an offshoot of the Sierra Nevada. The south side of this rock, which consists of disintegrated limestone, as well as the other hills, is covered with thick bushes of *Opuntia vulgaris*, which are now in flower, and whose fruit yield a favourite food to the lower classes. Interspersed are everywhere seen the *Agave americana*, which is here quite wild and very generally now in bloom. For instance, I have seen in the environs of the Capella San Miguel, on the southern slope of the valley of the Darro, more than twenty specimens together in a small space, whose flowering stems reached a height of 12 to 20 feet. Both plants ascend in the warm valleys of the Sierra Nevada, for instance in that of the Jenil, to a height of 3000 feet. Copses of elms, impenetrable hedges of *Rubus fruticosus*\*, *Bupleurum fruticosum*, L., *Coriaria myrtifolia*, L., interspersed with *Lonicera etrusca*, Santi, *Clematis cirrhosa*, DeC., *Cl. Flammula*, L., and other climbers, clothe the northern slopes of the valleys; whilst the arid, sunny hills, destitute of all shrubby vegetation, are covered with a number of *Labiata* (several *Thymi* and *Teucria*, especially *T. Polium*, L., *Ballota hirsuta*, Bth., *Origanum virens*, Lk. and Hoffmsegg.), accompanied by several species of *Ononis*, *Rubiaceæ* and *Compositæ*, as an *Andryala*, *Delphinium peregrinum*, L., *Ruta montana*, Clus., *R. angustifolia*, L., *Antirrhinum molle*, L., &c. On shady walls—frequent for instance on the walls of the Alhambra as well as on the aqueducts—grows the *Tra-*

\* This *Rubus*, the only species which I have hitherto met with in Spain, but which seems to be everywhere frequent, belongs to the *Rubus digitatifolius*, in the Div. II.\*\* *R. candicantes* of Reichenbach's 'Flora,' and is very different to the *R. fruticosus*, L., which belongs to the Div. I., as well as to the species in Div. II. Boissier enumerates it in his Voyage, under No. 601, as *R. fruticosus*, L., without adding any remark. I regard it as new, and propose to call it *R. hispanicus*.

*R. hispanicus*, turionum fol. omnibus quinato-digitatis, foliolis oblongo-lanceolatis, caulis floriferi fol. ternatis, foliolis oblongis aut ellipticis, lateralibus sæpe bilobis, corymbo composito erecto multifloro, floribus amplis roseis, calyce fructifero reflexo, mora mediocri atra nitida ex acinis parvis numerosis composita, dulcissima. Frutex 12-pedalis et ultra, turionibus longissimis decurvatis 5-angularibus subtomentosis infra purpurascensibus superne læte-virescentibus, fol. omnibus supra obscure virentibus subulis albo-tomentosis, aculeis conformibus recurvis numerosis, calyce pedunculisque divergentibus cano-tomentosis, laciniis calycis ovatis, petalis calyce duplo longioribus obovatis roseis. Differt a *R. fruticoso*, L., foliolis tomentosis oblongis nec glabris cordato-ovatis, corymbo composito nec simpliciter, turionibus tomentosis decurvatis nec glabris erectis, petalis roseis nec albis; a *R. discoloro*, Whe., cui maxime affinis, foliolis turionum oblongo-lanceolatis nec suborbicularibus, aculeis recurvatis nec rectiusculis, mora aterrima nec atro-cærulea.—I have frequently observed this beautiful species (No. 157 of my Spanish Plants), which forms impenetrable and entangled hedges, and bears flowers and fruit in uncommon abundance (the bunches of fruit attain the length of one foot), around Valencia, in the Sierra de Chiva, in Murcia, in the Mancha near Aranjuez, Madrid and Escorial, and in Andalusia, where they grow in the valleys of the Sierra Nevada up to a height of 4500 feet, and are common, especially in the environs of the village of Guejar. In Andalusia this *Rubus* bears the name of 'Sarza mora.'

*cheliu m caruleum*, L., which is also found in the low warm valleys of the Sierra Nevada: from the rocks hang down the thorny branches of *Capparis spinosa*, L., mingled with *Sedum amplexicaule*, Boiss.; and in the moist grassy valleys, in the shade of willows and elms, is frequently found *Dorycnium rectum*, Ser., *Mentha rotundifolia*, L., *Lythrum Salicaria*, L., *Epilobium hirsutum*, L., *Retama sphaerocarpa*, Boiss., and *Chamaepeuce hispanica*, DeC., which occurs in the Sierra Nevada up to a height of 4500 feet.

As soon as I had made all arrangements requisite to prolong my stay in the Sierra Nevada, whose lofty mountains attracted me irresistibly, I quitted Granada; and accompanied by a merry Andalusian, who acted at once as servant, guide and assistant, as well as a capital beast of burden, I set out for the Cortijo de S. Geronimo, which consists of a few scattered dwellings lying about 4500 feet above the sea, the highest inhabited spot on the northern side of the mountain, whose inhabitants still retain a clear recollection of Boissier. The Sierra Nevada is, with the exception of the mountain-ridges which enclose the valleys, almost wholly bare, and is even deficient for the greater part in the 'Monte bajo,' which everywhere covers the Spanish mountains. All the lower portion of the northern slope consists of limestone, in part interrupted by a beautiful marble, which for instance at S. Geronimo and Guejar forms immense rocks. In some places are found traces of coal (for example at the north foot of the Cerro Trevenque) and mines of mica (as on the southern slope of the Dornajo); and on the Cerro Calal, at the village of Guejar, are still found some lead-mines, which are now abandoned. I have however not succeeded in finding any trace of fossils in the whole of this limestone range. These limestone mountains rise to a height of 7000 to 7500 feet, and the highest and most interesting summits are those of the mountains Dornajo, Cerro Tesoro and Cerro Trevenque, in the neighbourhood of S. Geronimo. At S. Geronimo the gneiss formation commences, which in the snow-region passes into the micaceous slate and constitutes the highest chain of the Sierra, whose highest peak is the Cerro Mulehacen (said to be 11,600 feet), Picacho de Veleta (11,200 feet), Cerro Alcasava and Cerro Caballo. The region which is scarcely to be termed that of eternal snow, since every summer it melts, with the exception of some scattered snow-fields (hitherto I have nowhere observed the glaciers of which Boissier speaks), begins at about the height of 8500 to 9000 feet, and is clearly distinguished by its geognostical nature as well as by its highly peculiar vegetation from the lower regions. Traces of iron are here found frequently. The alpine region commences at a height of about 6000 feet, and the mountain region at 3500 feet. The environs of the Cortijo de S. Geronimo, on the southern slope of the magnificent alpine valley through which the rapid Monachil takes its course, form those districts of the entire northern declivity which abound most in water, and consequently in plants. The northern ridge, enclosing the valley known by the name of the Dehesa de S. Geronimo, whose highest slaty ridge rises to 8000 feet, is especially remarkable for its arboraceous luxuriance, being almost

wholly covered with copses of various species of oak (especially *Qu. Ilex*, L. and *Qu. Toza*, Bosc.), *Berberis vulgaris*, var. *australis*, *Crataegus granatensis*, Boiss., *Cotoneaster granatensis*, Boiss., &c. Rye and barley are cultivated high up in the alpine region, whilst in the valley and on the southern slope much wheat, maize, *Phaseolus communis* and *Cicer arietinum*, are grown.

In the very first excursion which I made into a side valley of the Dehesa, I found the two celebrated trees discovered by Boissier, *Lonicera arborea* and *Adenocarpus decorticans*, both in fruit. *L. arborea* has a very shrubby growth; but I have observed single trees, from twenty to thirty feet high, which were then mostly crowned by a rounded top of thick foliage. This rare tree, which according to Webb is also found in Asia Minor, has a fissured grayish-brown and almost leathery bark, and leaves of a dark green on the upper side and somewhat shining, and underneath of a sea-green colour. I have not observed any flowers; the berries are oval, and when ripe black. This *Lonicera* is somewhat frequent, both in the valleys of the Dehesa and in the ravines of the south side of the valley, and ascends to 7000 feet,—nearly to the limit of the region of trees. The *Adenocarpus decorticans* is much more frequent, especially in single spots, but it does not grow at a height exceeding 5500 feet. The lowest point at which I have seen it is in the valley of the Jenil, below Guejar, at a height of about 2500 feet. In that valley, where I first found it, I met with only small trees, all growing on the north side, on an arid limestone soil; but it is much more frequent in the copse of *Pinus sylvestris*, which bears the name 'La Cartejuela,' and covers the saddle between the Cerro Tesoro and Trevenque, as well as on the northern slope of the valley, through which the river Maydena flows, where it forms the arboraceous vegetation together with the *Quercus Toza*. This tree, which from its narrow and small leaves appears at a distance to be a *Conifer*, and has quite the habitus of shrubs of the *Juniperus communis*, attains a height of twelve to twenty feet, and a thickness of half a foot. The yellowish-white wood is very tough, and its yellowish-brown bark separates even from the youngest branches, and hangs down from the whole stem in long riband-like bands, whilst the ground all around is covered with pieces of bark shed from the tree. Beside these two trees, which are peculiar to the Sierra, the following also are found:—*Sorbus Aria*, L., which ascends from the rocks at the Monachil to the limit of the region of trees, accompanied by the *Cotoneaster granatensis*, Boissier, which still decorates the highest northern limestone rocks of the Dornajo and Trevenque, and is especially frequent in the wide valley between the Cerro Tesoro and Trevenque; *Acer opulifolium*, Vill. (*A. granatense*, Boissier, El. 39.), on the rocks near the Monachil, frequently in fruit; *Pinus sylvestris*, L., which forms the above-mentioned Cartejuela; *Salix Caprea*, L., only a few specimens in the upper part of the valley; *S. alba*, around the Cortijo, more frequent in the valley of the Jenil; *S. purpurea*, ditto; and *Taxus baccata*, L., on the upper Monachil, rare. The southern declivity lying opposite to the Dehesa, as far as the limestone formation and the mountain

region extends, is almost entirely covered with thorny shrubs, of the *Berberis vulgaris*, L., var. *australis*, *Cratægus granatensis*, Boiss., *Prunus Ramburei*, Boiss., *Rhamnus infectorius*, L., and *Cerasus prostrata*, DeC., which forms small and very entangled and stiff shrubs, from half a foot to three foot high, and is found as far as the highest summit of the Dornajo, where, creeping up the loose rocks, it covers them like a kind of moss. In very isolated spots, under the thorny shrub, grows the beautiful *Lonicera splendida*, Boiss., which is distinguished from *L. Caprifolium*, L., and *L. implexa*, Ait. (to which it is nearest allied), partly by the many-flowered racemes, and partly by the white dust on the under side of the evergreen leaves and of the young branches. The berries are oval, large and orange-coloured. *L. etrusca*, Santi, is found in the neighbourhood of brooks, in shady bushes, generally in company with the *Clematis Flammula*, L. On the banks of the Monachil I found frequent the *Rumex pulcher*, L., *Delphinium pentagynum*, Desf., *Thalictrum glaucum*, Desf., *Nepeta granatensis*, Boiss., *Junci*, *Euphorbiæ*, and two *Resedæ*; in the upper part of the valley, *Heracleum granatense*, Boiss., with *Cochlearia glastifolia*, L., and *Aspidium nevadense*, Boiss. The shady clefts of the rocks are decorated with patches of the delicate and fragile *Linaria villosa*, DeC., and *L. verticillata*, Boiss., along with *Hieracium amplexicaule*, L.; whilst on the sunny limestone and marble rocks of the southern declivity are found the pretty *Campanula Læfflingii*, Brot., in company with *Putoria calabrica*, T., several *Teucria* and others.

Among those portions of the limestone alps which are the most celebrated as producing the rarest plants, the Dornajo and Cerro Trevenque occupy undoubtedly the first place. The latter, above 7000 feet high, presents a huge pyramid of rock, and is seldom ascended by the inhabitants of the mountain on account of its extraordinary steepness. I ascended it on the 7th of August, accompanied by my servant. We first followed the steep bed of a rivulet filled with blocks of marble, which contributes the waters of its little stream to the Monachil, and soon saw ourselves surrounded with some isolated pines, which announced the Cartejuela. In this copse-wood, which is scarcely to be called thick, as well as in the ascent, I found frequent the tender *Reutera gracilis*, Boiss., of the habitus of an *Asperula*, as well as the *Pæonia coriacea*, Boiss., which is not rare on the Dehesa, S. Geronimo, and even around the Cortijo. When we had reached the plateau, about 6000 feet, I first ascended the Cerro Tesoro, lying on the right, and of a not much greater elevation, whose entire northern declivity is covered with *Anthyllis erinacea* (common throughout the whole limestone alps) and a thorny *Astragalus*. Besides the *Passerina Tartouraira*, L., which is here very small-leaved, *Anthyllis tejedensis*, Boiss., and *Ononis cephalotus*, Boiss., the vegetation consists of the same plants as I had already found on the Dornajo. The *Odontites longiflora*, Webb, is found, as well as on the Dornajo, from the base to the summit; in the clefts of the rocks grow on both mountains *Potentilla caulescens*, L., forming hard thick beds, in company with *Arenaria Armeriastrum*, Boiss.,

*Cerastium repens*, L., *Ptilotrichum longicaule*, Boiss., &c. From Cerro Tesoro I descended to the Cartejuela, where there are several springs,—a rare occurrence in these frightfully arid limestone alps. With the exception of a few very scattered specimens of *Vicia lutea*, L., and *Hypericum hyssopifolium*, L., there was scarcely anything of importance to be found; in May the vegetation may be more interesting. In that part which lies at the foot of the Trevenque, whose immense cone rises here proudly, the *Adenocarpus decorticans* is, as I have said, very common; besides this, the *Juniperus Sabina*, L., and *Arctostaphylos Uva-ursi* grow in great abundance, as well as *Bupleurum spinosum*, L. fil., which is found very abundant on many spots of the limestone portion of the Sierra, and grows as low down as 3000 feet and more.

At length we gained the base of the cone of the Cerro Trevenque, the ascent of which I undertook from the east side. This, as well as the western declivity, is almost wholly filled with steep rocks and boulders of limestone, and it was often necessary to dig out steps in the soft limestone sand to get a firm footing. Notwithstanding these circumstances, so unfavourable to vegetation, the rarest plants are found on this very side, as for instance, *Scabiosa pulsatilloides*; Boiss., *Helianthemum pannosum*, Boiss., *Santolina elegans*, Boiss. (the only locality for this plant hitherto known is the Trevenque, and even here it is rare), *Convolvulus nitidus*, Boiss., *Anthyllis tejedensis*, Boiss., *Ononis cephalotes*, Boiss. On the highest summit, from whence there is an indescribably beautiful view over the whole limestone alps, as well as the charming Vega of Granada as far as the Sierra Morena, no plants worthy of mention grow, except the *Cotoneaster granatensis*, Boiss., and some trees of *Pinus sylvestris*. The whole northern declivity is covered with *Arctostaphylos Uva-ursi*.

Excepting these spots, which are distinguished by rare plants, the vegetation of the limestone range is throughout very uniform. As far as the warm region extends, the hills and mountains are covered with the same plants which I have already mentioned in the environs of Granada. The *Berberis vulgaris*, var. *australis*, characterizes the mountain region, and extends into the alpine region, and is everywhere common, especially on arid sunny spots. Besides this, the *Salvia officinalis*, L., together with another species of this genus clothed with a thick white wool, *Santolina rosmarinifolia*, Mill., *Helichryson serotinum*, Boiss., *Daphne Gnidium*, L., *Lavandula lanata*, Boiss., an *Andryala* and a *Thymus* are the principal constituents of this mountain flora. The *Inula montana*?, the beautiful *Echium albicans*, Lag., and others, are limited to some localities. Of *Cryptogamia*, beside some few mosses and liverworts, some *Algæ* and *Aspidium nevadense*, Boiss., there are only lichens, apparently in great quantity, especially of the genera *Parmelia*, *Lecidea* and *Verrucaria*.

#### No. V. GUEJAR DE LA SIERRA, September 5.

Since the middle of August I have been staying in this village, which is situated in the valley of the Jenil, about 3000 feet above

the level of the sea,—the highest on the north side of the Sierra Nevada. In spite of its lofty position, one might fancy oneself in the neighbourhood of Granada, this village being surrounded by the most luxuriant vegetation of the warm region. Fig- and almond-trees raise their heads in the dells, even in the mountain region, and are almost to be considered wild here, while the slope of the valley lying to the north of the village is partly clothed with luxuriant chestnut trees, succeeded by an extensive wood of *Quercus Ilex*. The whole valley of the Jenil, the chief river of the north, is considerably wider and deeper than that of the Monachil and Dilar, and therefore much warmer. The banks of the river are bordered, from Granada to a league above Guejar, with thick woods of *Salix alba*, L., *Populus nigra* and *alba*, *Ulmus campestris*, L., and *Celtis australis*, L., which latter tree occurs in countless numbers in the immediate environs of the village. The underwood consists of the already-mentioned *Rubus*, *Coriaria myrtifolia*, *Daphne Gnidium* and *Retama sphaerocarpa*, while the numerous impenetrable hedges are composed exclusively of *Rubus hispanicus* and *Elæagnus angustifolia*, with a species of *Clematis*, *Tamus communis*, L., and *Asparagus albus*, L., running over them. *Feniculum vulgare*, Gærtn., with other *Umbelliferae*, are plentiful along the river. In some places *Hypericum baticum*, Boiss., *Chlora perfoliata*, L., &c. *Mentha rotundifolia*, L., is most abundant in moist shady spots, in company with *Euphorbia*, species of *Atriplex* and *Chenopodium*, *Plumbago europæa*, L., *Origanum virens*, Lk. et Hoffmsegg., *Heliotropium europæum*, L., and *Althæa cannabina*, L. On the rugged cliffs of marble I found a *Dianthus* common, with *Bupleurum gibraltarium*, Lam., and in the shady dells to the northward *Hypericum Cuprifolium*, Boiss., *Pyrethrum Parthenium*, L., *Lithospermum officinale*, L., *Epilobium hirsutum*, L. On dry sandy places, in sunny fields and on the road-sides grew *Senecio linifolius*, L., ascending as far as the alpine region, *Picnomon Acarna*, Cass., with other thistles, and in a single place, *Cynara alba*, Boiss. For the rest, the vegetation is exactly the same as in the other parts of the limestone alps.

Very different from the above-described vegetation of the limestone districts of the Sierra Nevada is that of the primary rocks, which begins at a height of about 4000 to 5000 feet. The flora of the lower mountain region agrees tolerably with that of the mountain limestone, but in the upper region and the alpine portion many other plants make their appearance. Among trees and shrubs *Quercus Ilex* and *Quercus Toza* especially prevail, mingled with *Lonicera arborea* and *Cratægus granatensis*, which rise to the highest alpine valleys and are the most beautiful trees here. *Adenocarpus decorticans* also occurs frequently; more rarely, *Cerasus Avium*, *Pyrus Aria* and *Taxus baccata*. The whole upper mountain and lower alpine region is clothed with *Genista aspalathoides*, DeC., and *Astragalus aristatus*, L'Hérit., with a woody stem often as thick as a man's arm; both ascend to the snow-region, where I have even found the latter in flower. The mountain region is also particularly characterized by *Artemisia campestris*, L., var. *glutinosa*, Ten., which

spreads over all the mountains, in many places alternating with *A. camphorata*, L., while *A. Absinthium* is abundant chiefly in the alpine region. In the bogs and springy places of the mountain region, especially in the upper part of the valley of the Jenil, *Helosciadium nodiflorum*, Koch, occurs frequently, and *Anagallis tenella*, L., in company with a *Lythrum* and *Senecio*, *Juncus glaucus*, L., which also fills all the bogs of the limestone formation, and is the commonest species in the Sierra; a few *Carices* are also met with; while on very dry, sunny places, with soil of a stony hardness, particularly in the neighbourhood of the châteaux, *Merendera Colchicum*, Ram., are still in flower in countless numbers. The upper alpine and lower snow-region is the richest in rare plants, peculiar to and most plentiful in these mountains. These consist almost solely of micaceous slate, the stratification of which has an inclination of about 20° from south to north. Accordingly the north slope of the chief alpine chain is encompassed by much steeper and sometimes formidable perpendicular cliffs and precipices than the south side, which is almost everywhere covered with loose masses of slate rock. On this side, in the passes between the highest peaks of the mountain-chain, pools or small mountain-lakes are frequently met with, occasionally of unfathomable depth, as for instance the famous Laguna de Vacares: these lakes are more rare on the north side. The main valleys, which extend to the snow-region, terminate in peculiar scattered meadows, watered by many springs and brooks, and sometimes perpetually inundated, and in grassy, often very steep declivities. These peculiar meadows bear the name of Borreguiles, and are particularly distinguished by their vegetation from the rest of the snow-region. Excepting these green meadows the snow-region presents from a distance a forbidding and seemingly quite sterile appearance, for nothing is seen but gray boulders of slate; but between the several masses of this rock grow a number of small alpine plants, often scarcely an inch high, mostly in thick patches. The beautiful *Ptilotrichum spinosum*, Boiss., which ascends from the valleys of the lower alpine region up to the highest summits of the snow-region, is generally diffused and very frequent. Besides this, the following plants occur on almost every part of the summit:—1. In the upper alpine region: *Senecio Tournefortii*, Lap., *β. granatensis*, Boiss., very frequent on moist loose masses of rock ascending into the snow-region; *Thymus angustifolius*, Pers.; *Dianthus brachyanthus*, Boiss. (here and in the snow-region scarcely an inch high, whilst in the limestone alps it reaches a height of from half a foot to one foot); *Plantago serpentina*, Vill.; *Jurinea humilis*, DeC.; *Eryngium Bourgati*, Gou., also in the snow-region; *Armeria allioides*, Boiss., especially on steep rocky declivities; *Hieracium Pilosella*, L., var. *incanum*, Boiss.; *Arenaria tetraquetra*, L., var. *granatensis*, Boiss., in the thickest beds up to the highest summit of the snow-region, mingled here and there with a small form of *A. Armeriastrum*, Boiss.—2. In the lower snow-region, at about 8500 to 9500 feet: *Arenaria tetraquetra*, L., var. *A. pungens*, Clem.; *Ptilotrichum purpureum*, Boiss.; *Ranunculus demissus*, DeC., var. *hispanicus*, Boiss.; *Plantago nivalis*, Boiss., on moist and grassy loose masses of rock, on



both sides of the Sierra, exceedingly frequent; *Anthyllis Webbiana*, Hook.; *Pyrethrum radicans*, Lag.; *Lepidium stylatum*, Lag.; *Eryngium glaciale*, Boiss., very frequent up to the highest summits; *Silene Boryi*, Boiss.; *Cerastium ramosissimum*, Boiss.; *Carduus carlinoides*, DeC.; *Herniaria alpina*, L.; *Jasione amethystina*, Lag.; *Armeria australis*, Boiss., a most striking shrubby form, with stiff, almost spinescent branches; *Agrostis nevadensis*, Boiss.—In the upper snow-region, 9500 to 11,000 feet and above: *Viola nevadensis*, Boiss.; *Saxifraga mixta*, Lag.; *Linaria origanifolia*, DeC.,  $\gamma$ . *glareosa*, Boiss.; *L. supina*, DeC., var. *nevadensis*, Boiss., rare; *Artemisia granatensis*, Boiss., known and celebrated as a popular medicine under the name of Manzanilla; *Umbilicus sedoides*, DeC.; besides *Eryngium glaciale*, *Ptilotrichum purpureum*, *Pyrethrum radicans*, *Jasione amethystina*, *Sideritis scordioides*, var., and *Agrostis nevadensis*.

Upon the above-mentioned Borreguiles are found in particular the following plants: *Saxifraga stellaris*, L., also frequent near the rivulets of the upper alpine region; *Stellaria cerastioides*, L.; *Campanula Herminii*, Lk. and Hoffmsegg.; *Pedicularis verticillata*, L.; *Euphrasia minima*, Schleich.; *Reseda complicata*, Bory, descending into the alpine valleys; *Ranunculus angustifolius*, var. *uniflorus*, DeC.; *R. acetosellæfolius*, Boiss.; *Veronica alpina*, L.; *Gentiana verna*, L., also frequent on the banks of the alpine lakes; *G. Pneumonanthe*, var. *depressa*, Boiss., especially on the Borreguil de S. Juan; *Pinguicula leptoceras*, Rehb.; *Lotus corniculatus*, var. *glacialis*, Boiss. (very different from the typical form!); *Sempervivum tectorum*, L. ?; *Meum athamanticum*, L.; *Epilobium origanifolium*, Lam.

The following plants appear to be more limited to certain localities of the snow-region, but are there frequent: *Saxifraga oppositifolia*, L., which I met with most beautiful on the frightful precipice on the northern declivity of the Mulehacen, called the Val de Casillas; *Butinia bunioides*, Boiss., in rocky clefts near the Laguna de Dilar; *Senecio quinqueradiatus*, Boiss., on the way to the perpendicular groups of rocks called the Pollo de Vacares, and in the Val de Casillas; *Nepeta Nepetella*, L., ditto; *Vicia pyrenaica*, Pourr., very sparingly in the Val de Casillas and in the upper part of the Barranco de Guelnon, &c.

In the highest part of the great valleys stretching into the snow-region the following are very frequent: *Parnassia palustris*, L., in many places very small; *Euphorbia Esula*, L.; *Cirsium acaule*, var. *gregarium*, Boiss.; *Carum verticillatum*, Koch; *Aconitum Lycoctonum*, L., and *A. Napellus*, L. Among the rarest plants of the snow-region are the *Potentilla nevadensis*, Boiss., which I have hitherto found only in small quantities on the Borreguil of S. Juan, and *Linaria glacialis*, Boiss., a small grayish-green and very large-flowered species, of which I have only met with three specimens in the highest snow-region. From the valleys of the upper mountain region,—for example, from the banks of the Monachil at S. Geronimo up to the snow-region,—the *Digitalis purpurea*, L., is found frequent, which at a height of from 8000 to 9000 feet takes a somewhat different habitus, but seems to me not sufficiently to differ from the typical form

to be regarded as a distinct species, especially as we find various forms of transition at different heights.

Among the most interesting points of the snow-region and the whole primitive rocks is the Corral de Veleta, a deep and frightful basin situated on the northern declivity of the Picacho de Veleta, whose rocky sides are perpetually filled with snow, and on which are the sources of the principal branch of the Jenil, which flows down hence through the deep Barranco de Guelnon, and afterwards unites with the two other small rivulets proceeding from the Barranco del Real and the Barranco de Vicares. A narrow steep path, partly over loose masses of rock, partly over snow and ice, leads from the lofty precipice, above 10,000 feet in height, down into the rocky basin, whose highest patches of meadow are about 9000 feet high. Around the margin of the Corral de Veleta I found especially beautiful the *Artemisia granatensis*, *Sempervivum tectorum*, *Ptilotrichum purpureum*, and *Gentiana verna*: on the descent, the *Brassica Cheiranthus*, Vill., var. *montana*, DeC.; *Ranunculus acetosellaefolius*, *Lepidium stylatum*: on dripping mossy perpendicular sides of rock, between masses of ice, the *Montia fontana*, L.; *Stellaria cerastioides*; *Veronica alpina*: but on the level meadows, the *Gentiana verna*, with *G. alpina*, L., *Plantago nivalis*, *Pinguicula leptoceras*, *Lotus corniculatus*, var. *glacialis*, *Luzula spicata*, *Phleum pratense*, &c.

The cryptogamous flora of the primitive rocks is, as respects the ferns and mosses, far richer than that of the limestone alps, but as regards the lichens, poorer. Of ferns I found *Ceterach officinarum*, W., very sparingly; most frequent, especially on the shores of the Laguna de Dilar, a species similar to the *Aspidium falcatum*, in company with *Cystopteris fragilis* and *Cheilanthes odora*; besides these are found *Asplenium Trichomanes*, *A. Filix fœmina*, *Aspidium Filix mas* and *A. nevadense*. Of the *Lycopodiaceæ* I have hitherto found no trace in the entire Sierra; on the other hand, the *Equisetum sylvaticum* is frequent on the banks of the Jenil in the upper warm region. The alpine rivulets of the Borreguiles are filled in parts with several liverworts, especially a species belonging to Nees von Esenbeck's genus *Chiloscyphus*; but I have hitherto not seen any in fructification, which is the case also with a large number of mosses. Algæ are rare, and of the Fungi I have hitherto observed only a few *Coniomyces* on the leaves of the *Quercus Ilex* and the stems of *Reseda complicata*, Bory. Of lichens there are scarcely any, except stone lichens, amongst others especially a reddish-yellow, but little-fructifying *Parmelia*, up to the highest rocks of the Picacho de Veleta, Mulehacen and Cerro Alcasana.

I have now, as far as time permitted, gone through the portion of the northern side of the Sierra Nevada which lies between the rivers Agua blanca, Maydena, Jenil, Monachil and Dilar; and I purpose now to explore the south side of the range, in the district known by the name of the Alpujarras.